NIF Discovery Science Program: Opportunities for Frontier Science on NIF

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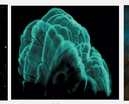
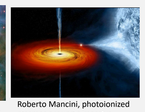
This year's 2020 selection of Discovery Science projects spans heat flow in galaxy clusters, star formation dynamics, accreting black holes, and the EOS of white dwarf envelopes

Gianluca Gregori, thermal transport in turbulent magnetized plasmas



Laurent Masse, Landau-Darieus instability in combustion and SNe-1A

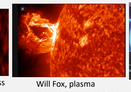
Sabrina Nagel, Christoph Federrath, turbulent star formation dynamics



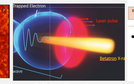
Roberto Mancini, photoionized plasmas around a massive accreting black hole

Didier Saumon, white dwarf envelopes

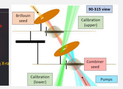
Frederico Fiuza, collisionless shock particle acceleration



Will Fox, plasma magnetic reconnection



Felicie Albert, laser wake field x-ray jet



Patrick Poole, laser beam combiner

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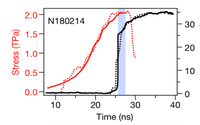
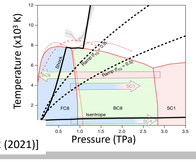
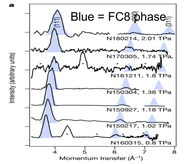
Diffraction experiments from ramp-compressed diamond to 2 TPa (20 Mbar) on NIF remained in the ambient FC8 phase, vs the predicted BC8 phase

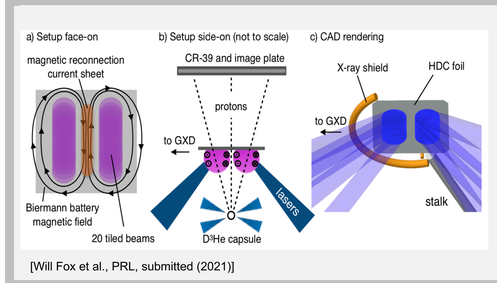


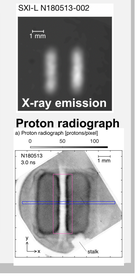




[A. Lazicki et al., Nature 589, 532 (2021)]

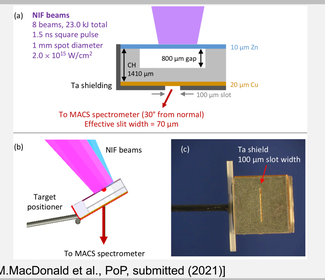
New regimes of magnetic reconnection relevant to HED astrophysical settings are being explored in NIF Discovery Science experiments

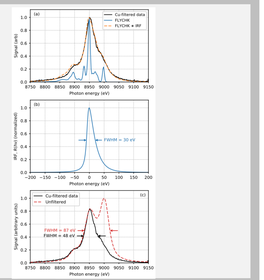




[Will Fox et al., PRL, submitted (2021)]

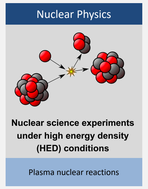
Laser-driven, narrow spectral bandwidth x-ray source development on NIF for collective x-ray scattering experiments



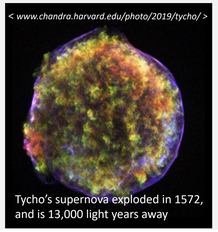


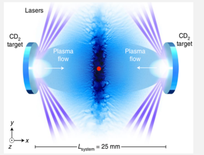
[M.MacDonald et al., PoP, submitted (2021)]

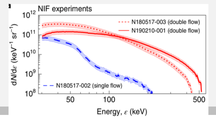
Nuclear reactions, planetary interiors, stellar interiors, and supernova explosions are examples of NIF Discovery Science projects



Collisionless shocks, turbulence, and plasma particle acceleration relevant to supernova remnants and cosmic ray generation are also being studied on NIF

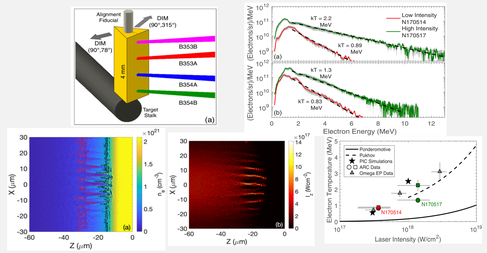






[F. Fiuza et al., Nature Physics, 16, 916 (2020); J.S. Ross et al., PRL 118, 185003 (2017)]

Production of relativistic electrons at subrelativistic laser intensities on NIF ARC



[J. Williams,PRE101, 031201(R)\(2020))]

Recent papers from the NIF Discovery Science program (2019-2020)

Materials Science:

A.L. Kritcher, "Lab. EOS measurements of the carbon envelopes of white dwarf stars," Nature **584**, 51-54 (2020).

Joseph Nilsen, "Understanding the effects of radiative preheat from shock heating on EOS msmts at 100s of Mbar using spherically converging shock waves in a NIF hohlraum," Matter Radiat. Extrem. **5**, 018401 (2020).

J.R. Rygg, "X-ray diffraction at the NIF," RSI **91**, 043902 (2020).

A. Lazicki, "Metastability of diamond ramp compressed to 2 TPa," (20 Mbar), Nature, (2021).

M.G. Gorman, "Crystal structures of Mg electrides at terapascal pressures," to be submitted to Nature, (Oct. 2020).

Hydrodynamics:

J.P. Sauppe, "Demonstration of scale-invariant Rayleigh-Taylor instability growth in laser-driven cylindrical implosion experiments," PRL **124**, 185003 (2020).

S. Palaniyappan, "Hydro-scaling of direct-drive cylindrical implosions at Omega and NIF," Phys. Plasmas **27**, 042708 (2020).

B.A. Remington, "Rayleigh-Taylor instabilities in high-energy density settings on the NIF," PNAS **116**, 18233-18238 (2019).

A. Casner, "From ICF to laboratory astrophysics: ablative and classical Rayleigh-Taylor instability experiments in turbulent-like regimes," Nucl. Fusion 59, 032002 (2019).

C. Mailliet, "Long-duration direct drive hydrodynamics experimentson the NIF: Platform development and numerical modeling with CHIC," Phys. Plasmas **26**, 082703 (2019).

Plasma Physics:

F. Fiuza, "Electron acceleration in laboratory-produced turbulent collisionless shocks," Nat. Physics **16**, 916-920 (2020).

A.G. MacPhee, "Enhanced laser-plasma interactions using non-imaging optical concentrator targets," Optica **7**, 129-130 (2020).

G.J. Williams, "Production of relativistic electrons at sub-relativistic laser intensities" (ARC), PRE **101**, 031201 (R) (2020).

D.P. Higginson, "Kinetic effects on neutron generation in moderately collisional interpenetrating plasma flows," Phys. Plasmas **26**, 012113 (2019).

D. Mariscal, "First demonstration of ARC-accelerated proton beams at the NIF," Phys. Plasmas **26**, 043110 (2019).

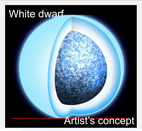
Will Fox, "Fast magnetic reconnection in highly-extended current sheets at the NIF Facility," PRL, submitted (2020).

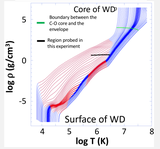
P.L. Poole, "Time-resolved measurement of power transfer in plasma amplifier optic," PRL, submitted (2020).

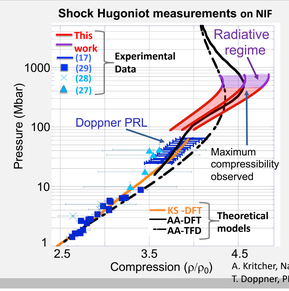
G.J. Williams, "Order of magnitude increase in target coupling at relativistic intensities using parabolic concentrators," to be submitted to Nature Communications, (Sept. 2020).

M.J. MacDonald, "Demonstration of a laser-driven, narrow bandwidth x-ray source for x-ray scattering experiments," to be submitted to Phys. Plasmas (Oct. 2020).

Matter is being studied at the high pressures and densities relevant to white dwarf envelopes through Discovery Science at the NIF laser

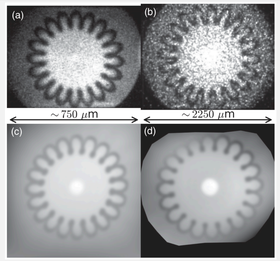


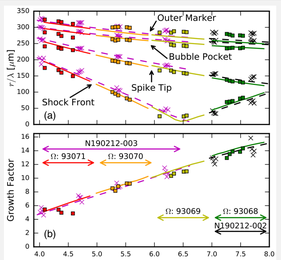




A. Kritcher, Nature (2020); T. Doppner, PRL (2018).

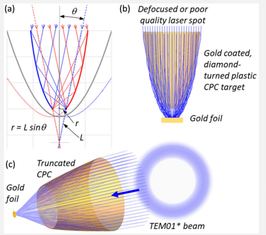
Scale invariant Rayleigh-Taylor experiments in cylindrical geometry on Omega and NIF

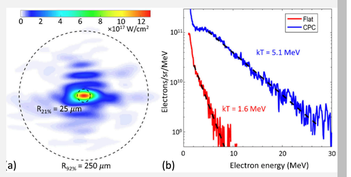




[J. Sauppe, PRL 124, 185003 (2020)]

Enhanced laser–plasma interactions using non-imaging optical concentrator targets





[A.G. MacPhee et al., Optica 7, 129 (2020)]

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